# Complete Summary

## GUIDELINE TITLE

ACC/AHA/ESC guidelines for the management of patients with atrial fibrillation. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the European Society of Cardiology Committee for Practice Guidelines and Policy Conferences (Committee to Develop Guidelines for the Management of Patients with Atrial Fibrillation).

## BIBLIOGRAPHIC SOURCE(S)

American College of Cardiology, American Heart Association, European Society of of Cardiology. ACC/AHA/ESC guidelines for the management of patients with atrial fibrillation. J Am Coll Cardiol 2001 Oct;38:1266i-lxx. [580 references]

Fuster V, Ryden LE, Asinger RW, Cannom DS, Crijns HJ, Frye RL, Halperin JL, Kay GN, Klein WW, Levy S, McNamara RL, Prystowsky EN, Wann LS, Wyse DG. ACC/AHA/ESC guidelines for the management of patients with atrial fibrillation. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the European Soci. Eur Heart J 2001 Oct;22(20):1852-923. [580 references] PubMed

## COMPLETE SUMMARY CONTENT



## SCOPE

### DISEASE/CONDITION(S)

Atrial fibrillation

### GUIDELINE CATEGORY

Evaluation
Management
Treatment

## CLINICAL SPECIALTY

Cardiology
Emergency Medicine
Family Practice
Internal Medicine

## INTENDED USERS

Physicians

## GUIDELINE OBJECTIVE(S)

- To produce guidelines that improve the effectiveness of care, optimize patient outcomes, and affect the overall cost of care favorably by focusing resources on the most effective strategies.
- To present a comprehensive review of the latest information about the definition, classification, epidemiology, mechanisms, and clinical characteristics of atrial fibrillation'
- To review the management of this complex and potentially dangerous arrhythmia

## TARGET POPULATION

Patients with atrial fibrillation

## INTERVENTIONS AND PRACTICES CONSIDERED

### Diagnostic Investigations

1. Clinical history, family history, assessment of triggers, and physical examination
2. Electrocardiogram by at least single-lead electrocardiogram recording during dysrhythmia
3. Chest radiography
4. Two-dimensional transthoracic echocardiography
5. Blood tests including thyroid function, serum electrolytes, and hemogram
6. Holter monitoring and exercise testing
7. Transesophageal echocardiography
8. Electrophysiological study

### Management

Cardioversion

1. Pharmacologic cardioversion with dofetilide, flecainide, ibutilide, propafenone, amiodarone, quinidine, procainamide, digoxin, or sotalol

2. Electrical cardioversion (external or internal transvenous electrical cardioversion)

### Maintenance of Sinus Rhythm after Cardioversion

1. Antiarrhythmics such as amiodarone, disopyramide, dofetilide, flecainide, propafenone, quinidine, or sotalol
2. Beta-blockers (e.g., propranolol)
3. Calcium channel blockers (verapamil, diltiazem)

### Nonpharmacological Correction of Atrial Fibrillation

1. Surgical ablation (maze operation)
2. Catheter ablation
3. Suppression of atrial fibrillation by pacing
4. Internal atrial cardioverter/defibrillators

### Pharmacological Control of Ventricular Rate

1. Digoxin
2. Calcium channel blockers (diltiazem and verapamil)
3. Beta-blockers, such as esmolol, metoprolol, propranolol, or atenolol
4. Amiodarone

### Non-Pharmacological Heart Rate Control

1. Ventricular pacing
2. Atrioventricular nodal ablation and permanent pacemaker implantation

### Antithrombotic Therapy

1. Risk stratification
2. Screening for the presence of thrombus by transesophageal echocardiography
3. Anticoagulants, such as warfarin, unfractionated heparin, or low-molecular-weight heparin, to achieve targeted international normalized ratio (INR) or partial thromboplastin time
4. Aspirin

### Special Considerations

Recommendations for the management of atrial fibrillation are provided for the following:

1. Postoperative atrial fibrillation
2. Acute myocardial infarction
3. Wolff-Parkinson-White preexcitation syndromes
4. Hyperthyroidism
5. Pregnancy
6. Hypertrophic cardiomyopathy
7. Pulmonary diseases

### MAJOR OUTCOMES CONSIDERED

- Cardioversion to sinus rhythm
- Maintenance of sinus rhythm
- Arrhythmia-free survival time
- Recurrence of atrial fibrillation
- Heart rate control
- Death/mortality rate
- Heart failure
- Rate of ischemic stroke
- Rate of thromboembolism
- Adverse effects of treatment (e.g., hemorrhagic complications)
- Quality of life

## METHODOLOGY

### METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

### DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

The American College of Cardiology/American Heart Association/European Society of Cardiology Committee to Develop Guidelines for the Management of Patients With Atrial Fibrillation conducted a comprehensive review of the relevant literature from 1980 to June 2000. Literature searches were conducted in the following databases: PubMed/Medline, EMBASE, the Cochrane Library (including the Cochrane Database of Systematic Reviews and the Cochrane Controlled Trials Registry), and Best Evidence. Searches were limited to English language sources and to human subjects. Major search terms included atrial fibrillation, aged, atrial remodeling, atrioventricular conduction, atrioventricular node, cardioversion, classification, clinical trial, complications, concealed conduction, cost-effectiveness, defibrillator, demographics, epidemiology, heart failure (HF), hemodynamics, human, hyperthyroidism, hypothyroidism, meta-analysis, myocardial infarction, nomenclature, pharmacology, postoperative, pregnancy, pulmonary disease, quality of life, rate control, risks, sinus rhythm, symptoms, and tachycardia-mediated cardiomyopathy.

### NUMBER OF SOURCE DOCUMENTS

Not stated

### METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Given)

### RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Levels of Evidence

A – The data were derived from multiple randomized clinical trials.

B – The data are based on a limited number of randomized trials, nonrandomized studies, or observational registries.

C – The primary basis for the recommendation was expert consensus.

## METHODS USED TO ANALYZE THE EVIDENCE

Review of Published Meta-Analyses
Systematic Review with Evidence Tables

## DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

Not stated

## METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus

## DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Experts in the subject under consideration are selected from the American College of Cardiology, the American Heart Association and the European Society of Cardilogy to examine subject-specific data and write guidelines. The process includes additional representatives from other medical specialty groups when appropriate. Writing groups are specifically charged to perform a formal literature review, weigh the strength of evidence for or against a particular treatment or procedure, and include estimates of expected health outcomes where data exist. Patient-specific modifiers, comorbidities, and issues of patient preference that might influence the choice of particular tests or therapies are considered as well as frequency of follow-up and cost-effectiveness.

## RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Class I: Conditions for which there is evidence for and/or general agreement that the procedure or treatment is useful and effective.

Class II: Conditions for which there is conflicting evidence and/or a divergence of opinion about the usefulness/ efficacy of a procedure or treatment.

Class IIa: The weight of evidence or opinion is in favor of the procedure or treatment.

Class IIb: Usefulness/efficacy is less well established by evidence or opinion.

Class III: Conditions for which there is evidence and/or general agreement that the procedure or treatment is not useful/effective and in some cases may be harmful.

## COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

## METHOD OF GUIDELINE VALIDATION

External Peer Review
Internal Peer Review

## DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

The document was reviewed by three reviewers nominated by the American College of Cardiology, three nominated by the American Heart Association, and three nominated by the European Society of Cardiology, as well as by the American College of Cardiology Clinical Electrophysiology Committee, the American Heart Association Electrocardiogram and Arrhythmia Committee, North American Society of Pacing Electrophysiology, and 25 additional reviewers nominated by the writing committee. The document was approved for publication by the governing bodies of the American College of Cardiology, American Heart Association, and European Society of Cardiology and officially endorsed by North American Society of Pacing Electrophysiology.

# RECOMMENDATIONS

## MAJOR RECOMMENDATIONS

Definitions for the weight of the evidence (A-C) and classes of recommendations (I-III) can be found at the end of the "Major Recommendations" field.

### Clinical Evaluation

The initial evaluation of a patient with suspected or proven atrial fibrillation includes characterizing the pattern of the arrhythmia as paroxysmal or persistent, determining its cause, and defining associated cardiac and extracardiac factors (see Table 4 titled "Minimum and Additional Clinical Evaluation in Patients With Atrial Fibrillation" in the full text guideline document).

### Recommendations for Pharmacological or Electrical Cardioversion of Atrial Fibrillation

Class I

1. Immediate electrical cardioversion in patients with paroxysmal atrial fibrillation and a rapid ventricular response who have electrocardiographic evidence of acute myocardial infarction or symptomatic hypotension, angina, or heart failure that does not respond promptly to pharmacological measures. (Level of Evidence: C)
2. Cardioversion in patients without hemodynamic instability when symptoms of atrial fibrillation are unacceptable. (Level of Evidence: C)

Class IIa

1. Pharmacological or electrical cardioversion to accelerate restoration of sinus rhythm in patients with a first-detected episode of atrial fibrillation. (Level of Evidence: C) (See Tables 6 through 8 in the full text guideline document for recommended drugs.)
2. Electrical cardioversion in patients with persistent atrial fibrillation when early recurrence is unlikely. (Level of Evidence: C)
3. Repeated cardioversion followed by prophylactic drug therapy in patients who relapse to atrial fibrillation without antiarrhythmic medication after successful cardioversion. (Level of Evidence: C)

Class IIb

1. Pharmacological agents for cardioversion to sinus rhythm in patients with persistent atrial fibrillation. (Level of Evidence: C) (See Tables 6 through 8 in the full text guideline document for recommended drugs.)
2. Out-of-hospital administration of pharmacological agents for cardioversion of first-detected, paroxysmal, or persistent atrial fibrillation in patients without heart disease or when the safety of the drug in the particular patient has been verified. (Level of Evidence: C) (See Table 8 titled "Recommended Doses of Drugs Proven Effective for Pharmacological Cardioversion of Atrial Fibrillation" in the full text guideline document.)

Class III

1. Electrical cardioversion in patients who display spontaneous alternation between atrial fibrillation and sinus rhythm over short periods of time. (Level of Evidence: C)
2. Additional cardioversion in patients with short periods of sinus rhythm who relapse to atrial fibrillation despite multiple cardioversion procedures and prophylactic antiarrhythmic drug treatment. (Level of Evidence: C)

Recommendations for Pharmacological Therapy to Maintain Sinus Rhythm

Class I

1. Base selection of pharmacological therapy to maintain sinus rhythm in patients with disabling or otherwise troublesome symptoms during atrial fibrillation predominantly on safety. (Level of Evidence: B)
2. Treat precipitating or reversible causes of atrial fibrillation before initiation of antiarrhythmic drug therapy. (Level of Evidence: C)

Class IIa

1. Administer pharmacological therapy to maintain sinus rhythm to prevent progression of tachycardia-induced cardiomyopathy due to atrial fibrillation. (Level of Evidence: C)
2. Infrequent and well-tolerated recurrence of atrial fibrillation may in some cases be deemed a successful outcome of antiarrhythmic drug therapy. (Level of Evidence: C)

3. Outpatient initiation of antiarrhythmic drug treatment is appropriate in selected patients. (Level of Evidence: C)

Class IIb

1. Administer pharmacological therapy to maintain sinus rhythm in asymptomatic patients to prevent atrial remodeling. (Level of Evidence: C)
2. Administer pharmacological therapy to maintain sinus rhythm to prevent thromboembolism or heart failure in selected patients. (Level of Evidence: C)
3. Administer combinations of antiarrhythmic agents to maintain sinus rhythm when single-drug therapy fails. (Level of Evidence: C)

Class III

1. Use of a particular pharmacological agent to maintain sinus rhythm in patients with well-defined proarrhythmia risk factors for that agent. (Level of Evidence: A)
2. Use of pharmacological therapy to maintain sinus rhythm in patients with advanced sinus node or atrioventricular node dysfunction in the absence of a functioning electronic cardiac pacemaker. (Level of Evidence: C)

Recommendations for Heart Rate Control in Patients with Atrial Fibrillation

Class I

1. Measure heart rate response both at rest and during exercise in patients with persistent or permanent atrial fibrillation and control the rate with pharmacological agents (using a beta-blocker or calcium channel antagonist in most cases) to the physiological range. (Level of Evidence: C)
2. Administer intravenous beta-blockers or calcium channel antagonists (verapamil, diltiazem) in the acute setting to slow the ventricular response to atrial fibrillation in the absence of conduction over an accessory pathway, exercising caution in patients with hypotension or heart failure. (Level of Evidence: B)
3. Perform immediate electrical cardioversion in patients with acute paroxysmal atrial fibrillation and a rapid ventricular response associated with acute myocardial infarction, symptomatic hypotension, angina, or cardiac failure that does not respond promptly to pharmacological measures. (Level of Evidence: C) (See the section titled "Recommendations for Pharmacological or Electrical Cardioversion of Atrial Fibrillation," above.)

Class IIa

1. Administer a combination of digoxin and a beta-blocker or calcium channel antagonist to control the heart rate at rest and during exercise in patients with atrial fibrillation. The choice of medication should be individualized and the dose modulated to avoid bradycardia. (Level of Evidence: C)
2. Employ nonpharmacological therapy to control heart rate when pharmacological therapy is insufficient. (Level of Evidence: C)

Class IIb

1. Administer digoxin as the sole agent to control heart rate at rest in patients with persistent atrial fibrillation. (Level of Evidence: B)
2. Administer intravenous quinidine, procainamide, disopyramide, ibutilide, or amiodarone to hemodynamically stable patients with atrial fibrillation involving conduction over an accessory pathway. (Level of Evidence: B)
3. Immediate cardioversion is required when very rapid tachycardia or hemodynamic instability occurs in patients with atrial fibrillation involving conduction over an accessory pathway. (Level of Evidence: B)

Class III

1. Administer digitalis as the sole agent to control a rapid rate of ventricular response to atrial fibrillation in patients with paroxysmal atrial fibrillation. (Level of Evidence: B)
2. Catheter ablation without prior medical therapy to control atrial fibrillation. (Level of Evidence: C)

Recommendations for Antithrombotic Therapy in Patients with Atrial Fibrillation

Class I

1. Administer antithrombotic therapy (oral anticoagulation or aspirin) to all patients with atrial fibrillation, except those with lone atrial fibrillation, to prevent thromboembolism. (Level of Evidence: A)
2. Individualize the selection of the antithrombotic agent, based on assessment of the absolute risks of stroke and bleeding and the relative risk and benefit for a particular patient. (Level of Evidence: A)
3. Chronic oral anticoagulant therapy in a dose adjusted to achieve a target intensity international normalized ratio of 2 to 3 in patients at high risk of stroke, unless contraindicated. (Level of Evidence: A)
    a. The need for anticoagulation should be reevaluated at regular intervals. (Level of Evidence: A)
    b. International normalized ratio should be determined at least weekly during the initiation of oral anticoagulation therapy and monthly when the patient is stable. (Level of Evidence: A)
4. Aspirin in a dose of 325 mg daily as an alternative in low-risk patients or in those with certain contraindications to oral anticoagulation. (Level of Evidence: A)
5. Oral anticoagulation for patients with atrial fibrillation who have rheumatic mitral valve disease or prosthetic heart valves (mechanical or tissue valves). (Level of Evidence: B)
    a. Base the target intensity of anticoagulation on the particular type of prosthesis, but not less than international normalized ratio 2 to 3. (Level of Evidence: B)

Class IIa

1. Target a lower international normalized ratio of 2 (range 1.6 to 2.5) for primary prevention of ischemic stroke and systemic embolism in patients over

75 years old considered at increased risk of bleeding complications but without frank contraindications to oral anticoagulant therapy. (Level of Evidence: C)
2. Manage antithrombotic therapy for patients with atrial flutter, in general, as for those with atrial fibrillation. (Level of Evidence: C)
3. Select antithrombotic therapy using the same criteria irrespective of the pattern of atrial fibrillation (i.e., for patients with paroxysmal, persistent, or permanent atrial fibrillation). (Level of Evidence: B)

Class IIb

1. Interrupt anticoagulation for a period of up to 1 week for surgical or diagnostic procedures that carry a risk of bleeding, without substituting heparin in patients with atrial fibrillation who do not have mechanical prosthetic heart valves. (Level of Evidence: C)
2. Administer unfractionated or low-molecular-weight heparin intravenously or subcutaneously respectively, in selected high-risk patients or when a series of procedures requires interruption of oral anticoagulant therapy for a period longer than 1 week. (Level of Evidence: C)
3. Manage patients with coronary artery disease with anticoagulation (international normalized ratio 2 to 3) based on the same criteria used for patients without coronary artery disease. (Level of Evidence: C)
    a. A low dose of aspirin (less than 100 mg per day) or clopidogrel (75 mg per day) may be given concurrently with anticoagulation, but these strategies have not been evaluated sufficiently and may be associated with an increased risk of bleeding. (Level of Evidence: C)
4. Treatment with aspirin is optional for primary prevention of stroke in patients under 60 years without heart disease or risk factors for thromboembolism (lone atrial fibrillation). (Level of Evidence: C)

Class III

1. Long-term anticoagulation for stroke prevention in patients under 60 years of age without heart disease (lone atrial fibrillation) and without risk factors for thromboembolism. (Level of Evidence: C)

<u>Recommendations for Antithrombotic Therapy to Prevent Ischemic Stroke and Systemic Embolism in Patients with Atrial Fibrillation Undergoing Cardioversion</u>

Class I

1. Administer anticoagulation therapy regardless of the method (electrical or pharmacological) used to restore sinus rhythm. (Level of Evidence: B)
2. Anticoagulate patients with atrial fibrillation lasting more than 48 h or of unknown duration, for at least 3 to 4 weeks before and after cardioversion (international normalized ratio 2 to 3). (Level of Evidence: B)
3. Perform immediate cardioversion in patients with acute (recent onset) atrial fibrillation accompanied by symptoms or signs of hemodynamic instability resulting in angina pectoris, myocardial infarction, shock, or pulmonary edema, without waiting for prior anticoagulation. (Level of Evidence: C)

    a. If not contraindicated, administer heparin concurrently by an initial intravenous bolus injection followed by a continuous infusion in a dose adjusted to prolong the activated partial thromboplastin time at 1.5 to 2 times the reference control value. (Level of Evidence: C)
    b. Next, provide oral anticoagulation (international normalized ratio 2 to 3) for a period of at least 3 to 4 weeks, as for patients undergoing elective cardioversion. (Level of Evidence: C)
    c. Limited data from recent studies support subcutaneous administration of low-molecular-weight heparin in this indication. (Level of Evidence: C)
4. Screening for the presence of thrombus in the left atrium or left atrium appendage by transesophageal echocardiography is an alternative for routine preanticoagulation in candidates for cardioversion of atrial fibrillation. (Level of Evidence: B)
    a. Anticoagulate patients in whom no thrombus is identified in the form of intravenous unfractionated heparin by an initial bolus injection before cardioversion, followed by a continuous infusion in a dose adjusted to prolong the activated partial thromboplastin time at 1.5 to 2 times the reference control value. (Level of Evidence: B)
    b. Next, provide oral anticoagulation (international normalized ratio 2 to 3) for a period of at least 3 to 4 weeks, as for patients undergoing elective cardioversion. (Level of Evidence: B)
    c. Limited data are available to support the subcutaneous administration of low-molecular-weight heparin in this indication. (Level of Evidence: C)
    d. Treat patients in whom thrombus is identified by transesophageal echocardiography with oral anticoagulation (international normalized ratio 2 to 3) for at least 3 to 4 weeks before and after restoration of sinus rhythm. (Level of Evidence: B)

Class IIb

1. Cardioversion without transesophageal echocardiography guidance during the first 48 h after the onset of atrial fibrillation. (Level of Evidence: C)
    a. In these cases, anticoagulation before and after cardioversion is optional, depending on assessment of risk. (Level of Evidence: C)
2. Anticoagulate patients with atrial flutter undergoing cardioversion in the same way as for patients with atrial fibrillation. (Level of Evidence: C)

<u>Recommendations for Prevention and Management of Postoperative Atrial Fibrillation</u>

Class I

1. Treat patients undergoing cardiac surgery with an oral beta-blocker to prevent postoperative atrial fibrillation, unless contraindicated. (Level of Evidence: A)
2. In patients who develop postoperative atrial fibrillation, achieve rate control by administration of atrioventricular nodal blocking agents. (Level of Evidence: B)

Class IIa

1. Administer sotalol or amiodarone prophylactically to patients at increased risk of developing postoperative atrial fibrillation. (Level of Evidence: B)
2. Restore sinus rhythm in patients who develop postoperative atrial fibrillation by pharmacological cardioversion with ibutilide or direct-current cardioversion, as recommended for nonsurgical patients. (Level of Evidence: B)
3. In patients with recurrent or refractory postoperative atrial fibrillation, attempt maintenance of sinus rhythm by administration of antiarrhythmic medications, as recommended for patients with coronary artery disease who develop atrial fibrillation. (Level of Evidence: B)
4. Administer antithrombotic medication in patients who develop postoperative atrial fibrillation, as recommended for nonsurgical patients. (Level of Evidence: B)

Recommendations for Management of Patients with Atrial Fibrillation and Acute Myocardial Infarction

Class I

1. Electrical cardioversion for patients with severe hemodynamic compromise or intractable ischemia. (Level of Evidence: C)
2. Intravenous administration of digitalis or amiodarone to slow a rapid ventricular response and improve left ventricular function. (Level of Evidence: C)
3. Intravenous beta-blockers to slow a rapid ventricular response in patients without clinical left ventricular dysfunction, bronchospastic disease, or atrioventricular block. (Level of Evidence: C)
4. Heparin for patients with atrial fibrillation and acute myocardial infarction, unless contraindications to anticoagulation are present. (Level of Evidence: C)

Class III

1. Administer type IC antiarrhythmic drugs in patients with atrial fibrillation in the setting of acute myocardial infarction. (Level of Evidence: C)

Recommendations for Management of Atrial Fibrillation and Ventricular Preexcitation

Class I

1. Catheter ablation of the accessory pathway in symptomatic patients with atrial fibrillation who have Wolff-Parkinson-White syndrome, particularly those with syncope due to rapid heart rate or those with a short bypass tract refractory period. (Level of Evidence: B)
2. Immediate electrical cardioversion to prevent ventricular fibrillation in patients with Wolff-Parkinson-White in whom atrial fibrillation occurs with a rapid ventricular response associated with hemodynamic instability. (Level of Evidence: B)
3. Intravenous procainamide or ibutilide in an attempt to restore sinus rhythm in patients with Wolff-Parkinson-White in whom atrial fibrillation occurs without hemodynamic instability in association with a wide QRS complex on the

electrocardiogram (greater than or equal to 120 ms in duration). (Level of Evidence: C)

Class IIb

1. Administer intravenous quinidine, procainamide, disopyramide, ibutilide, or amiodarone to hemodynamically stable patients with atrial fibrillation involving conduction over an accessory pathway. (Level of Evidence: B)
    a. Immediate cardioversion is required when very rapid tachycardias or hemodynamic instability occurs in patients with atrial fibrillation involving conduction over an accessory pathway. (Level of Evidence: B)

Class III

1. Intravenous administration of beta-blocking agents, digitalis glycosides, diltiazem, or verapamil in patients with Wolff-Parkinson-White syndrome who have preexcited ventricular activation in atrial fibrillation. (Level of Evidence: B)

Recommendations for Management of Atrial Fibrillation in Patients with Hyperthyroidism

Class I

1. Administer a beta-blocker as necessary to control the rate of ventricular response in patients with atrial fibrillation complicating thyrotoxicosis, unless contraindicated. (Level of Evidence: B)
2. In circumstances when a beta-blocker cannot be used, administer a calcium channel antagonist (diltiazem or verapamil) to control the ventricular rate. (Level of Evidence: B)
3. In patients with atrial fibrillation associated with thyrotoxicosis, use oral anticoagulation (international normalized ratio 2 to 3) to prevent thromboembolism, as recommended for atrial fibrillation patients with other risk factors for stroke. (Level of Evidence: C)
    a. Once a euthyroid state is restored, recommendations for antithrombotic prophylaxis are the same as for patients without hyperthyroidism. (Level of Evidence: C)

Recommendations for Management of Atrial Fibrillation During Pregnancy

Class I

1. Control the rate of ventricular response with digoxin, a beta-blocker, or a calcium channel antagonist. (Level of Evidence: C)
2. Electrical cardioversion in patients who become hemodynamically unstable due to the dysrhythmia. (Level of Evidence: C)
3. Administer antithrombotic therapy (anticoagulant or aspirin) throughout pregnancy to all patients with atrial fibrillation (except those with lone atrial fibrillation). (Level of Evidence: C)

Class IIb

1. Attempt pharmacological cardioversion by administration of quinidine, procainamide, or sotalol in hemodynamically stable patients who develop atrial fibrillation during pregnancy. (Level of Evidence: C)
2. Administer heparin to patients with risk factors for thromboembolism during the first trimester and last month of pregnancy. Unfractionated heparin may be administered either by continuous intravenous infusion in a dose sufficient to prolong the activated partial thromboplastin time to 1.5 to 2 times the control (reference) value or by intermittent subcutaneous injection in a dose of 10,000 to 20,000 units every 12 h, adjusted to prolong the mid-interval (6 h after injection) activated partial thromboplastin time to 1.5 times control. (Level of Evidence: B)
    a. Limited data are available to support the subcutaneous administration of low-molecular-weight heparin for this indication. (Level of Evidence: C)
3. Administer an oral anticoagulant during the second trimester to patients at high thromboembolic risk. (Level of Evidence: C)

Recommendations for Management of Atrial Fibrillation in Patients with Hypertrophic Cardiomyopathy

Class I

1. Treat patients with hypertrophic cardiomyopathy who develop atrial fibrillation with oral anticoagulation (international normalized ratio 2 to 3) as recommended for other high-risk patients for prevention of thromboembolism. (Level of Evidence: B)

Class IIa

1. Antiarrhythmic medications to prevent recurrences. Available data are insufficient to recommend one agent over another in this situation, but disopyramide and amiodarone are generally preferred. (Level of Evidence: C)

Recommendations for Management of Atrial Fibrillation in Patients with Pulmonary Diseases

Class I

1. In patients who develop atrial fibrillation during an acute pulmonary illness or exacerbation of chronic pulmonary disease, correction of hypoxemia and acidosis are the primary therapeutic measures. (Level of Evidence: C)
2. In patients with obstructive pulmonary disease who develop atrial fibrillation, a calcium channel antagonist agent (diltiazem or verapamil) is preferred for ventricular rate control. (Level of Evidence: C)
3. Attempt electrical cardioversion in patients with pulmonary disease who become hemodynamically unstable owing to atrial fibrillation. (Level of Evidence: C)

Class III

1. Use of theophylline and beta-adrenergic agonist agents in patients with bronchospastic lung disease who develop atrial fibrillation. (Level of Evidence: C)
2. Use of beta-blockers, sotalol, propafenone, and adenosine in patients with obstructive lung disease who develop atrial fibrillation. (Level of Evidence: C)

Definitions:

Level of Evidence

A – The data were derived from multiple randomized clinical trials.

B – The data are based on a limited number of randomized trials, nonrandomized studies, or observational registries.

C – The primary basis for the recommendation was expert consensus.

The indications for the management of patients with atrial fibrillation have been divided into three classes:

Class I:

Conditions for which there is evidence for and/or general agreement that the procedure or treatment is useful and effective.

Class II:

Conditions for which there is conflicting evidence and/or a divergence of opinion about the usefulness/ efficacy of a procedure or treatment.

Class IIa:

The weight of evidence or opinion is in favor of the procedure or treatment.

Class IIb:

Usefulness/efficacy is less well established by evidence or opinion.

Class III:

Conditions for which there is evidence and/or general agreement that the procedure or treatment is not useful/effective and in some cases may be harmful.

## CLINICAL ALGORITHM(S)

Algorithms are provided for:

- Pharmacological Management of Patients with Newly Discovered Atrial Fibrillation

- Pharmacological Management of Patients with Recurrent Paroxysmal Atrial Fibrillation
- Antiarrhythmic Drug Therapy to Maintain Sinus Rhythm in Patients with Recurrent Paroxysmal or Persistent Atrial Fibrillation
- Pharmacological Management of Patients with Recurrent Persistent or Permanent Atrial Fibrillation

## EVIDENCE SUPPORTING THE RECOMMENDATIONS

### TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The recommendations are evidence based and derived primarily from published data. The weight of evidence is given for each recommendation (see the "Major Recommendations" field).

## BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

### POTENTIAL BENEFITS

- Cardioversion/restoration and maintenance of sinus rhythm
- Prevention of thromboembolism
- Prevention of heart failure
- Relief of symptoms
- Prevention of cardiomyopathy
- Prevention of recurrent atrial fibrillation
- Decreased mortality and morbidity
- Prevention of stroke
- Prevention of systemic embolism

Subgroups Most Likely to Benefit:

- Patients with prior stroke or transient ischemic attacks are at greater risk of subsequent stroke and benefit substantially from treatment with adjusted-dose anticoagulation. In addition to prior thromboembolism, independent risk factors for ischemic stroke in nonvalvular atrial fibrillation include heart failure, hypertension, increasing age, and diabetes mellitus. Female sex, blood pressure greater than 160 mm Hg, and left ventricular dysfunction have each been linked to stroke. Patients with atrial fibrillation related to thyrotoxicosis, which is often associated with congestive heart failure, are also at increased risk for stroke.
- Atrioventricular nodal ablation may be especially useful for patients with an excessive ventricular rate that induces tachycardia-mediated decline in ventricular systolic function despite appropriate medical therapy.

### POTENTIAL HARMS

General

Cardioversion carries a risk of thromboembolism unless anticoagulation prophylaxis is initiated before the procedure, and this risk appears greatest when the arrhythmia has been present more than 48 hours.

Pharmacologic Cardioversion

- Amiodarone: Adverse effects include bradycardia, hypotension, visual disturbances, nausea, and constipation after oral administration and phlebitis after peripheral intravenous administration. Serious toxicity has been reported, including one death due to bradycardia ending in cardiac arrest. Other potential adverse effects are QT prolongation, pulmonary toxicity, photosensitivity, torsades de pointes (rare), hepatic toxicity, skin discoloration, hypothyroidism, corneal deposits, optic neuropathy, warfarin interaction, and proarrhythmia.
- Dofetilide: Potential adverse effects are QT prolongation and torsade de pointes.
- Flecainide: Arrhythmias, including atrial flutter with rapid ventricular rates and bradycardia after conversion, are relatively frequent adverse effects. Transient hypotension and mild neurological side effects may also occur.
- Ibutilide: There is a small but definite risk of torsade de pointes ventricular tachycardia. Hypotension is an infrequent adverse response. QT prolongation is another potential adverse effect.
- Propafenone: Adverse effects are uncommon but include rapid atrial flutter, ventricular tachycardia, intraventricular conduction disturbances, hypotension, and bradycardia at conversion.
- Quinidine: Potential adverse effects of quinidine include QT-interval prolongation that may precede torsade de pointes ventricular tachycardia, nausea, diarrhea, fever, hepatic dysfunction, thrombocytopenia, and hemolytic anemia. During the initiation of quinidine therapy, hypotension and acceleration of the ventricular response to atrial fibrillation may occur on a vagolytic basis.
- Beta-blockers (e.g., propranolol, esmolol, metoprolol): Hypotension and bronchospasm (asthma)are the major adverse effects of esmolol and other beta-blockers. Heart block, heart failure, and bradycardia may also occur.
- Calcium channel blockers: (verapamil and diltiazem): Negative inotropic effects contribute to toxicity, which includes hypotension. Both verapamil and diltiazem can cause heart block and heart failure, and verapamil may interact with digoxin.
- Digoxin: Digoxin has few adverse effects after acute administration in therapeutic doses, aside from atrioventricular block and acceleration of ventricular ectopy. Digitalis toxicity and bradycardia are other potential adverse effects.
- Disopyramide: Adverse effects include dryness of mucosal membranes, especially of the mouth; constipation; urinary retention; torsides de pointes, heart failure, glaucoma, and depression of left ventricular contractility.
- Procainamide: Hypotension is the major adverse effect after intravenous administration of procainamide. Long-term treatment with procainamide is frequently associated with development of antinuclear antibodies and is occasionally associated with arthralgias or agranulocytosis. Other potential adverse effects are torsade de pointes and gastrointestinal symptoms.

- Sotalol: Sotalol has the potential for serious adverse effects, including torsade de points ventricular tachycardia, congestive heart failure, bradycardia, and exacerbation of chronic obstructive or bronchospastic lung disease.

### Electrical Cardioversion

- Embolism: Thromboembolic events have been reported in between 1% and 7% of patients who did not receive prophylactic anticoagulation before cardioversion of atrial fibrillation.
- Arrhythmias: Various benign arrhythmias may arise after cardioversion that commonly subside spontaneously, especially ventricular and supraventricular premature beats, bradycardia, and short periods of sinus arrest. More dangerous arrhythmias, such as ventricular tachycardia and fibrillation, may be precipitated in patients with hypokalemia or digitalis intoxication.
- Myocardial injury: Animal experiments show a wide margin of safety between the energy required for cardioversion of atrial fibrillation and that associated with clinically relevant myocardial depression. Even without apparent myocardial damage, however, transient ST-segment elevation may appear on the electrocardiogram after cardioversion, and blood levels of creatine kinase may rise. In a study of 72 elective cardioversion attempts involving an average energy greater than 400 J (range 50 to 1280 J), serum troponin-T and -I levels did not rise significantly. There was a small increase in creatine kinase-MB mass levels above the proportion attributable to skeletal muscle trauma in 10% of patients, and this was related to the energy delivered. Myocardial damage, even on a microscopic level, related to direct-current cardioversion has not been confirmed and is probably not clinically significant.

### Surgical Ablation

The mortality rate of an isolated maze operation is less than 1%, but mortality is higher when the procedure is combined with other types of operative repair. The morbidity associated with the maze operation includes consequences common to median sternotomy and cardiopulmonary bypass, as well as a risk of short-term fluid retention (due to reduced release of atrial natriuretic peptide), transient reduction in left atrium and right atrium transport function, and early postoperative atrial tachyarrhythmias. In addition, when the blood supply to the sinus node is disrupted, sinus node dysfunction may require permanent pacemaker implantation.

### Catheter Ablation

Potential complications of catheter ablation for atrial fibrillation include systemic embolism, pulmonary vein stenosis, pericardial effusion, cardiac tamponade, and phrenic nerve paralysis.

### Atrioventricular Nodal Ablation

- This technique has several limitations, including the inadvertent induction of complete atrioventricular block and a relatively high risk of increasing ventricular rate over the first 6 months after ablation.

- Complications of atrioventricular nodal ablation include those of pacemaker implantation, as well as ventricular arrhythmias, relatively rare instances of worsened left ventricular function, thromboembolism associated with interruption of anticoagulation, and a greater rate of progression from paroxysmal to persistent atrial fibrillation. The 1-year mortality rate after atrioventricular nodal ablation and permanent pacemaker implantation is approximately 6.3%, with a risk of sudden death of approximately 2.0%.
- The limitations of this technique include the persistent need for anticoagulation, loss of atrioventricular synchrony, and lifelong pacemaker dependency. There is a small but real risk of sudden death due largely to torsade de pointes. In addition, ablation of the atrioventricular conduction system may preclude or limit the later use of newer nonpharmacological treatments. Patients with impaired diastolic ventricular compliance who are most dependent on atrioventricular synchrony for maintenance of cardiac output (such as those with hypertrophic cardiomyopathy or restrictive cardiomyopathies) may experience persistent symptoms after atrioventricular nodal ablation and permanent pacemaker implantation.

Anticoagulation

- Bleeding
- Anticoagulation increases the frequency and severity of major extracranial and intracranial hemorrhage.

Subgroups Most Likely to be Harmed:

- Propafenone should be used cautiously or not at all for conversion of atrial fibrillation in patients with organic heart disease and should be avoided in patients with congestive heart failure or obstructive lung disease.
- Overall, adverse reactions have been reported slightly more frequently with flecainide than with propafenone, and these drugs should be given cautiously or avoided entirely in patients with underlying organic heart disease involving abnormal ventricular function.
- Combining aspirin with an anticoagulant at higher anticoagulation intensities may accentuate intracranial hemorrhage, particularly in elderly atrial fibrillation patients.
- Cardioversion of patients with implanted pacemaker and defibrillator devices is feasible and safe when appropriate precautions are taken to prevent damage. Pacemaker generators and defibrillators are designed with circuits protected against sudden external electrical discharges, but programmed data may nevertheless be altered by sudden current surges. Electricity conducted along an implanted electrode lead to the endocardium may cause myocardial injury associated with a temporary or permanent increase in stimulation threshold. When pronounced, this may cause exit block that results in failure of ventricular capture. The implanted device should be interrogated immediately before and after cardioversion to verify appropriate pacemaker function and should be reprogrammed if necessary to increase generator output.

## CONTRAINDICATIONS

### CONTRAINDICATIONS

Electrical cardioversion is contraindicated in cases of digitalis toxicity because the ventricular tachyarrhythmias that are provoked may be difficult to terminate.

## QUALIFYING STATEMENTS

### QUALIFYING STATEMENTS

These practice guidelines are intended to assist physicians in clinical decision-making by describing a range of generally acceptable approaches for the diagnosis, management, or prevention of specific diseases or conditions. These guidelines attempt to define practices that meet the needs of most patients in most circumstances. The physician and patient must make the ultimate judgment regarding care of a particular patient in light of general information and specific circumstances.

Atrial flutter is not addressed comprehensively in these guidelines but will be addressed in the upcoming American College of Cardiology/American Heart Association/European Society of Cardiology Guidelines on the Management of Patients With Supraventricular Arrhythmias.

The antiarrhythmic drugs listed in the original guideline document have been approved by federal regulatory agencies in the United States and Europe for clinical use, but their use for treatment of atrial fibrillation has not been approved in all cases. Furthermore, not all agents are approved for use in each country. Within each category, drugs are listed alphabetically. The recommendations given in this document are based on published data and do not necessarily adhere to the regulations and labeling requirements of governmental agencies.

## IMPLEMENTATION OF THE GUIDELINE

### DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

## INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

### IOM CARE NEED

Living with Illness

### IOM DOMAIN

Effectiveness

## IDENTIFYING INFORMATION AND AVAILABILITY

### BIBLIOGRAPHIC SOURCE(S)

American College of Cardiology, American Heart Association, European Society of of Cardiology. ACC/AHA/ESC guidelines for the management of patients with atrial fibrillation. J Am Coll Cardiol 2001 Oct;38:1266i-lxx. [580 references]

Fuster V, Ryden LE, Asinger RW, Cannom DS, Crijns HJ, Frye RL, Halperin JL, Kay GN, Klein WW, Levy S, McNamara RL, Prystowsky EN, Wann LS, Wyse DG. ACC/AHA/ESC guidelines for the management of patients with atrial fibrillation. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the European Soci. Eur Heart J 2001 Oct;22(20):1852-923. [580 references] PubMed

### ADAPTATION

Not applicable: The guideline was not adapted from another source.

### DATE RELEASED

2001 Oct

### GUIDELINE DEVELOPER(S)

American College of Cardiology Foundation - Medical Specialty Society
American Heart Association - Professional Association
European Society of Cardiology - Medical Specialty Society

### SOURCE(S) OF FUNDING

The American College of Cardiology Foundation, the American Heart Association, and the European Society of Cardiology. No outside funding accepted.

### GUIDELINE COMMITTEE

Committee to Develop Guidelines for the Management of Patients With Atrial Fibrillation

American College of Cardiology/American Heart Association Task Force on Practice Guidelines

European Society of Cardiology Committee for Practice Guidelines and Policy Conferences

### COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Committee Members: Valentin Fuster, MD, PhD, FACC, Chair; Lars E. Rydén, MD, PhD, FACC, FESC, Co-Chair; Richard W. Asinger, MD, FACC; David S. Cannom, MD, FACC; Harry J. Crijns, MD, FESC; Robert L. Frye, MD, MACC; Jonathan L.

Halperin, MD, FACC; G. Neal Kay, MD, FACC; Werner W. Klein, MD, FACC, FESC; Samuel Lévy, MD, FACC, FESC; Robert L. McNamara, MD, MHS, FACC; Eric N. Prystowsky, MD, FACC; L. Samuel Wann, MD, FACC; D. George Wyse, MD, PhD, FACC

Task Force Members: Raymond J. Gibbons, MD, FACC, Chair; Elliott M. Antman, MD, FACC, Vice Chair; Joseph S. Alpert, MD, FACC; David P. Faxon, MD, FACC; Valentin Fuster, MD, PhD, FACC; Gabriel Gregoratos, MD, FACC; Loren F. Hiratzka, MD, FACC; Alice K. Jacobs, MD, FACC; Richard O. Russell, MD, FACC*; Sidney C. Smith, Jr, MD, FACC

*Former Task Force Member during this effort.

European Society of Cardiology Committee for Practice Guidelines and Policy Conferences Members: Werner W. Klein, MD, FACC, FESC, Chair; Angeles Alonso-Garcia, MD, FACC, FESC; Carina Blomström-Lundqvist, MD, PhD, FESC; Guy De Backer, MD, PHD, FACC, FESC; Marcus Flather, MD, FESC; Jaromir Hradec, MD, FESC; Ali Oto, MD, FACC, FESC; Alexander Parkhomenko, MD, FESC; Sigmund Silber, MD, PhD, FESC; Adam Torbicki, MD, FESC

## FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

The American College of Cardiology/American Heart Association (ACC/AHA) Task Force on Practice Guidelines makes every effort to avoid any actual or potential conflicts of interest that might arise as a result of an outside relationship or personal interest of a member of the writing panel. Specifically, all members of the writing panel are asked to provide disclosure statements of all such relationships that might be perceived as real or potential conflicts of interest. These statements are reviewed by the parent task force, reported orally to all members of the writing panel at the first meeting, and updated yearly and as change occur.

## ENDORSER(S)

Heart Rhythm Society - Professional Association

## GUIDELINE STATUS

This is the current release of the guideline.

An update is not in progress at this time.

## GUIDELINE AVAILABILITY

Electronic copies: Available from the American College of Cardiology (ACC) Web site:

- HTML Format
- Portable Document Format (PDF)

Print copies: Available from the American College of Cardiology, Resource Center, 9111 Old Georgetown Rd, Bethesda, MD 20814-1699; (800) 253-4636 (US only). Also available from AHA, Public Information, 7272 Greenville Ave, Dallas TX 75231-4596; Reprint No. 71-0209.

Electronic copies: Also available in Portable Document Format (PDF) from the European Society of Cardiology (ESC) Web site.

Print copies: Available from Elsevier Publishers Ltd. 32 Jamestown Road, London, NW1 7BY, United Kingdom. Tel +44.207.424.4200/ Tel: +44 207 424 4389; Fax: +44 207 424 4433; e-mail: gr.davies@elsevier.com; Web site: www.escardiocontent.org.

## AVAILABILITY OF COMPANION DOCUMENTS

The following is available:

- ACC/AHA/ESC guidelines for the management of patients with atrial fibrillation: executive summary. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the European Society of Cardiology Committee for Practice Guidelines and Policy Conferences (Committee to Develop Guidelines for the Management of Patients with Atrial Fibrillation). J Am Coll Cardiol 2001 Oct;38(4):1231-66; Circulation 2001 Oct 23;104(17):2118-50.

Electronic copies: Available from the American College of Cardiology (ACC) Web site in HTML Format, and Portable Document Format (PDF)

- ACC/AHA pocket guidelines for atrial fibrillation

Electronic copies: Available from the ACC Web site, and from the American Heart Association (AHA) Web site

Print copies: Available from the American College of Cardiology, Resource Center, 9111 Old Georgetown Rd, Bethesda, MD 20814-1699; (800) 253-4636 (US only). Also available from AHA, Public Information, 7272 Greenville Ave, Dallas TX 75231-4596; Reprint No. 71-0208.

## PATIENT RESOURCES

None available

## NGC STATUS

This summary was completed by ECRI on February 27, 2002. The information was verified by the guideline developer on September 4, 2002.

## COPYRIGHT STATEMENT

Date Modified: 10/4/2004